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# THE IMPACT OF CLIMATE ON HOLIDAY DESTINATION CHOICE

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**Abstract.** The holiday destination choice is analysed for tourists from 45 countries, representing all continents and all climates. Tourists are deterred by distance, political instability and poverty, and attracted to coasts. Tourists prefer countries with a sunny yet mild climate, shun climates that are too hot or too cold. A country's tourists' aversion for poverty and distance can be predicted by that country's average per capita income. The preferred holiday climate is the same for all tourists, independent of the home climate. However, tourists from hotter climates have more pronounced preferences.

## 1. Introduction

Tourism is one of the largest economic sectors in the world. Tourists are sensitive to climate: Mass tourism continues to seek sun, sea and sand (Aguilo et al., 2005).[1] Tourism is therefore sensitive to climate change (Maddison, 2001; Lise and Tol, 2002; Hamilton, 2003). This combination makes the impact of climate change on tourism potentially one of the largest of all of the market impacts of climate change. Indeed, Berritella et al. (2004) find large impacts of climate change on tourism already by 2050. However, previous estimates of the relationship between climate and tourist destination choice suffer from two major drawbacks. Firstly, tourists from only a few countries are analysed. This potentially biases the results. Secondly, domestic tourism is not explicitly included. The potential bias of this is larger, as domestic tourism is about 5 times as large as international tourism (Bigano et al., 2004). This paper seeks to overcome these two drawbacks by looking at the destination choice of tourists from 45 countries from all levels of development and all climates. The tourists travel to 200-odd countries, including the home country.

Previous papers on climate change and tourism have focussed on biophysically constructed comfort indices (see, for example, Scott and McBoyle, 2001; Amelung and Viner, in press), and on potential impacts and adaptation of particular tourism resorts (see, for example, Gable, 1997; Harrison et al., 1999; Perry, 2000; Lohmann, 2001; Elsasser and Bürki, 2002). Other papers, which include destination

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characteristics, are closer to the analysis presented here. Maddison (2001), Lise and Tol (2002), and Hamilton (2003) use micro-data of UK, Dutch and German tourists, respectively, to statistically estimate the relationship between destination choice, various climate indices and a range of other explanatory variables. In the paper by Hamilton, the origin country, Germany, was included in the destination choice set. See Hamilton and Tol (2004) for an extensive review of the literature on the impacts of climate change on tourism.

Compared to international tourism, there are relatively few studies on domestic tourism. There are some studies, however, that examine the trends in domestic tourism for particular countries: for example, Australia (Faulkner, 1988), China (Wen, 1997) and Germany (Coles, 2003). In some developing countries, domestic tourism has been increasing rapidly (Wen, 1997; Ghimire, 2001), whereas in developed countries such as Australia and Germany domestic tourism is relatively stable. The geographical spread of domestic tourists is different from international tourists and domestic tourists and from domestic holidaymakers and those visiting friends and relatives (see, for example, Seaton and Palmer, 1997; Seckelmann, 2002). Some studies argue that tourists behave differently on a domestic holiday compared to an international holiday (see Carr, 2002). Few attempts have been made to estimate demand functions for domestic tourism. In a study carried out for the North East of England, the demand function is restricted to the price of tourism in the region, the price of substitutes and the income of tourists (Seddighi and Shearing, 1997). Typically, demand estimation studies do not include destination characteristics (Morley, 1992).

Besides a detailed analysis of Dutch tourists, Lise and Tol (2002) also report a statistical analysis of aggregate data of tourism flows between selected OECD countries. It is this analysis that we extend here to include more origin countries and many more destination countries. As the analysis is at the aggregate level, many details are lost. In return, we obtain comprehensiveness.

The paper proceeds as follows. Section 2 presents the data. Section 3 shows the results for the 45 countries, as well as the consolidated results. Section 4 discusses and concludes.

## 2. The Data

### 2.1. INTERNATIONAL TOURISM

International tourism data for each country are taken from the World Tourism Organisation (WTO, 2003). Where available, we use Table I: international arrivals of tourists by *country of residence*. If not available, we use the alternative Table I: international arrivals of tourists by *nationality*. In the current study, no distinction is made between residence and nationality. If alternative Table I is also not available, we instead use Table IV: international arrivals of tourists in *all establishments*. If

TABLE I
Domestic tourism in the 10 most active and in the 10 least active countries[a]

| | Domestic tourists/residents | GDP per Capita 1997 | Area (sq km) |
|---|---|---|---|
| Least active countries | | | |
| Congo | 0.00778 | 815 | 342000 |
| Togo | 0.00406 | 349 | 56785 |
| Nicaragua | 0.00399 | 521 | 129494 |
| Albania | 0.00362 | 785 | 28748 |
| El Salvador | 0.00318 | 1702 | 21040 |
| Senegal | 0.00285 | 570 | 196190 |
| Kenya | 0.00231 | 338 | 582650 |
| Mali | 0.00224 | 262 | 1240000 |
| Niger | 0.00037 | 206 | 1267000 |
| Chad | 0.00014 | 224 | 1284000 |
| Most active countries | | | |
| Sweden | 4.79903 | 26766 | 449964 |
| Finland | 4.41692 | 26888 | 337030 |
| New Zealand | 4.12968 | 16834 | 268680 |
| United States | 3.67587 | 28651 | 9629091 |
| Australia | 3.52266 | 20843 | 7686859 |
| Canada | 2.67469 | 20225 | 9976140 |
| United Kingdom | 2.28203 | 20025 | 244820 |
| Poland | 2.24071 | 3482 | 312685 |
| Ireland | 1.87281 | 21083 | 70280 |
| Norway | 1.42087 | 36389 | 324220 |

[a]GDP per Capita is expressed in 1995 constant US Dollars. The entry for Nicaragua refers to 1996.

there is no Table IV either, we use Table III: international arrivals of tourists in *hotels*. Note that only very few countries report Tables I to IV. It is therefore not possible to estimate the bias introduced by mixing the data. Note also that WTO (2003, p. x) defines a tourist as "a visitor who stays at least one night in a collective or private accommodation in the country visited". This definition includes holidays, business trips, and visits to friends and family. The relative sizes of these three groups are not exactly known, but holiday makers are the largest group. Business trips and family visits are less sensitive to weather and climate than are holidays.

WTO (2003) reports the annual number of tourist arrivals for 1997–2001. In order to avoid choosing one particular year, in which there may have been major sporting events, disasters, terrorist attacks, or other such occurrences that affect tourism, we take the average of the annual number of arrivals over the period

1997–2001. This way we are able to smooth out annual variability. Germany generates the most international tourists (72 mln), followed by the USA (57 mln), the UK (53 mln), the Netherlands (24 mln) and France (22 mln). These numbers are not in proportion to population size, nor to per capita income. The high numbers for the three northwest European countries probably have to do with the high variability of summer weather and, for the Netherlands, the small country size, which makes any holiday at some distance from home an international holiday.

France is the most popular destination for international tourists (72 mln), followed by the USA (48 mln), Spain (40 mln), Italy (37 mln) and Mexico (20 mln). The popularity of France, Spain and Italy is explained by their proximity to Germany, the UK and the Netherlands, while Mexico profits from being close to the USA.

### 2.2. DOMESTIC TOURISM

For most countries, the volume of domestic tourist flows is derived using 1997 data contained in the Euromonitor (2002) database, which aligns its definitions with WTO (2003). For some other countries, we rely upon data from alternative sources, such as national statistical offices, other governmental institutions or trade associations. For some very small states (mostly city states[2]), we assumed that the number of domestic tourists is zero. Data are mostly in the form of number of trips to destinations beyond a non-negligible distance from the place of residence, and involving at least one overnight stay.[3] For some countries, data in such a format was not available, and we resorted to using either the number of registered guests in hotels, campsites, hostels etc., or the ratio of the number of overnight stays to the average length of stay. The latter formats underestimate domestic tourism by excluding trips to friends and relatives; nevertheless, we included such data for completeness, relying on the fact that dropping them did not lead to any dramatic change.[4] See Bigano et al. (2004) for a more extensive discussion and listing of sources.

For most countries, the number of domestic tourists is less than the national population, that is, people take a domestic holiday less than once a year; however, in 22 countries, residents took a holiday within their national borders more than once per year. Many factors may concur to explain this behaviour and a systematic analysis of them falls into the scope of the next sections. However, a preliminary look at the characteristics of countries, which display a marked domestic tourist activity, shows that these are in general rich countries, large (or at least medium-sized), and endowed with plenty of opportunities for domestic tourism. This definition fits in particular to the Scandinavian countries (4.8 domestic tourist trips per resident in Sweden) but also Canada, Australia, and the USA.[5]

In the USA, the combination of a large national area, a large number of tourist sites, high income per capita and the willingness to travel long distances contribute to explain why, on average, each American took a domestic holiday 3.67 times in 1997. The distance from the rest of the world is also important, and this is most probably the case for Australia and New Zealand, where there are plenty of opportunities for domestic tourism and it may take a very long journey to reach almost every international tourist destination. Table I shows the 10 most active and the 10 least active countries in terms of domestic tourism, for which we were able to collect data. For the 10 least active countries, the poverty of the vast majority of the population, probably combined with the lack of infrastructure and perhaps with cultural factors, make tourist travel a luxury for the lucky few.[6]

## 2.3. OTHER DATA

A number of explanatory variables are used in the regressions reported below. Per capita income is taken from WRI (2002), annual mean temperature from New et al. (1999), the number of World Heritage Sites from UNESCO (2004), area and coastline length from the CIA (2004) and the index of political stability from Kaufmann et al. (1999). The distance between countries is calculated as the great circles distance between the capital cities. The longitude and latitude of the capital cities are taken from (the index-gazetteer of) the Times Atlas (1994).

Per capita income is a proxy for economic well-being. Although this proxy is not perfect, it is superior to its alternatives. A priori, it is unclear whether tourists would be attracted to the low prices in poor countries, or deterred by poverty. Temperature is our proxy for climate. We use the annual mean temperature, which is closely correlated to monthly mean temperatures and the temperature of the coldest and hottest month.[7] Indices for weather stability are not available. Precipitation varies too much spatially. We expect that tourists dislike weather that is too cold and too hot. Therefore, we have temperature as well as temperature squared as explanatory variables. We use the average temperature over a country. This is obviously problematic for large countries, but we do not have a finer regional disaggregation of tourist destinations either. The number of World Heritage Sites is the only available proxy for the cultural attractiveness of countries. We expect that World Heritage Sites attract tourists. Area is included because larger countries are likely to have a greater amount of attractive features. Coastline length is included because the sea attracts tourists. Note that coastline length is not a proxy for beach length, for which data are not available. Political stability is included because instability deters tourists. Distance is a proxy for both travel costs and travel time. It is expected that both deter tourists. Unfortunately, no data on travel costs and travel time is at our disposal.[8] Distance between countries is measured as distance between capital cities. This is crude, but we do not have subnational information on either tourist destination or origin.[9]

Note that we use "objective" explanatory variables, even though what matters is the perception of the tourist. As tourist perceptions are not regularly measured, we assume that the perceived status of the destination is close to the "real" status. Obviously, other factors influence tourist destination choice as well (see Crouch, 1995; Witt and Witt, 1995, for literature reviews), but data of sufficiently quality and coverage is not available. Short term effects on tourist flows (e.g., major sport events, natural disasters, terrorist attacks) are not included either; instead, we use the five year average tourist flow.

## 3. Results

### 3.1. PRELIMINARY FINDINGS

We estimate the following relationship for all countries of origin:

$$\ln\left(A_i^j\right) = c^j + \delta_d^j + \delta_h^j + \delta_a^j + \alpha_1^j(1 - I_{i=j})\ln\left(D_i^j\right) + \alpha_2^j \ln(y_i) + \alpha_3^j T_i + \alpha_4^j T_i^2 + \alpha_5^j H_i + \alpha_6^j C_i + \alpha_7^j A_i + \alpha_8^j S_i \quad (1)$$

where $A_i^i$ denotes the arrivals in country $i$ from country $j$; $D_i^j$ is the distance between the two countries (the range of t-statistics for the 45 regressions is −8.96 to 1.29); $y_i$ is per capita income in the destination country (range of t-statistics 0.09 to 4.90); $T_i$ is the annual average temperature in the destination country (range of t-statistics, linear −2.10 to 4.61, quadratic −4.36 to 2.16); $H_i$ is the number of World Heritage Sites per million square kilometers in the destination country (range of t-statistics −2.57 to 2.30); $C_i$ is the length of the coast line of the destination country (range of t-statistics −2.36 to 3.31); $A_i$ is the land area of the destination country (range of t-statistics −0.91 to 3.77); and $S_i$ is an index of the political stability of the destination country (range of t-statistics −0.49 to 3.00); besides the constant $c$, we also estimate three dummies, viz. whether the tourists stay in their home country $(i = j)$ (range of t-statistics −5.66 to 4.59), whether the destination country reports only tourists arriving in hotels (range of t-statistics −2.38 to 2.15), or in all tourism establishments (range of t-statistics −3.01 to 0.57); the default reporting is for tourists arriving at the border.

Table A1 shows the results. Distance has a clear negative effect: destinations that are further away are less popular. Distance is significant at the 5% for all countries except Brazil, Switzerland and the USA. Per capita income in the destination country has a positive effect; tourists, particularly tourists from richer countries, generally do not like to witness poverty. Per capita income is significant at the 5% level for the Americas and Europe, except the Czech Republic, Germany, Hungary, and the Netherlands but is not significant for Africa, Asia and Australasia, except for Australia, China, India, Japan, and the Philippines. Temperature has a significant effect. The temperature parameters are jointly significant at the 5% level in all countries except Congo, Germany and Russia and the relationship, between temperature and the number of tourists, has the expected inverted-U shape in all countries except Germany and the Netherlands. Coast length has a positive effect or has no effect on tourist numbers; the coast length parameter is positive and significant in about half of the countries, without a pattern that can be easily interpreted. The Netherlands is the only country with a negative and significant relationship. The number of World Heritage Sites has a *negative* effect or has no effect, depending on the country of origin. The parameter is positive and significant for Indonesia and the Netherlands but it is negative and significant for Algeria, China, Germany, Saudi Arabia, Tunisia, and the USA. Area has a positive effect: larger countries attract more tourists. This parameter is insignificant for Argentina, New Zealand and the countries of Europe, apart from Greece, Poland and Russia. Political stability has a positive effect: the more stable the country, the more tourists it attracts. Stability is significant at the 5% level for Canada, the Czech Republic, Egypt, Hungary, Indonesia, Kenya, Malaysia, Mexico, South Africa, Sweden, Thailand and Turkey.

The regression results conform to our expectations, with three exceptions. The attitude of tourists from the Netherlands towards climate and coast is peculiar. It is odd that the World Heritage Sites appear to deter tourists. However, some peculiarities are to be expected with one standard regression for 45 different countries. It is strange that Dutch and German tourists prefer very hot and very cold destinations. For Germany, the U-curve relationship between temperature and attractiveness is of no concern, as neither the parameter for temperature nor the parameter for temperature squared is significantly different from zero. For the Netherlands, both parameters are significant. Note that Lise and Tol (2002) also report peculiar behaviour by Dutch tourists. Note also that there are only some 15 million Dutch people, a tiny fraction of the world population.

### 3.2. INTERPRETATION

Figure 1 shows the relationship between the optimal holiday temperature and the temperature in the country of origin. This relationship is largely absent. This is confirmed by a regression analysis. Figure 2 shows the relationship between $\alpha_4$, the parameter of the temperature squared in Equation (1), and the temperature in the country of origin. Here, there is a clear relationship. Weighted least squares, using the inverse of the standard error of the parameter estimates as weights, shows that this parameter falls by 2.5 (0.9) $10^{-4}$ for every degree increase in temperature.[10] Although people from hot countries prefer the same climate as people from cold countries, they are much more particular about their preferences, and have a greater dislike of tourist destinations that are too hot or too cold compared to the mean preferred climate.

The distance elasticity of arrivals falls with per capita income in the country of origin, with 5.4 (1.2) $10^{-5}$ per additional dollar. This is as expected: travel expenses are less relevant to the better-off. Poverty aversion, $\alpha_2$ in Equation (1), increase with

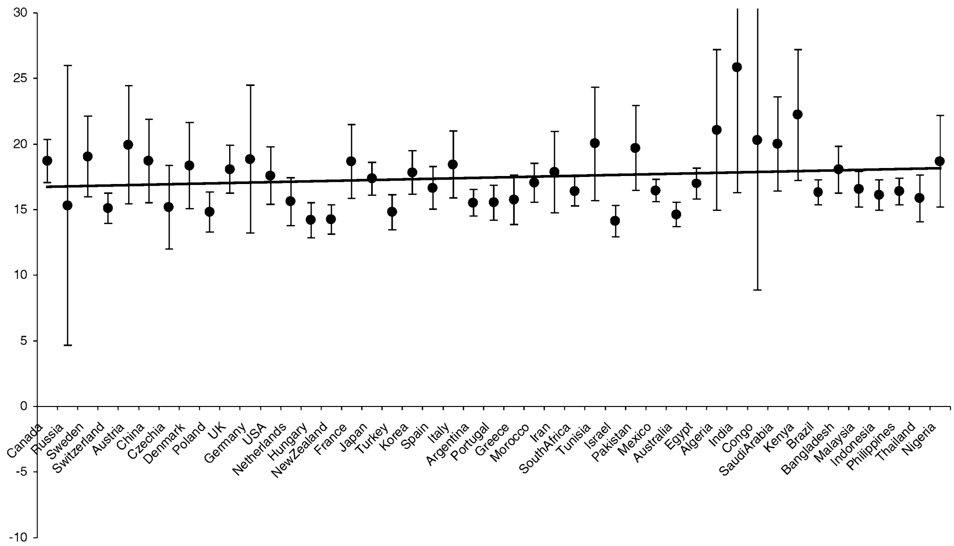


*Figure 1.* The optimal temperature for all countries of origin in the sample; the countries of origin are ranked according to their temperature.

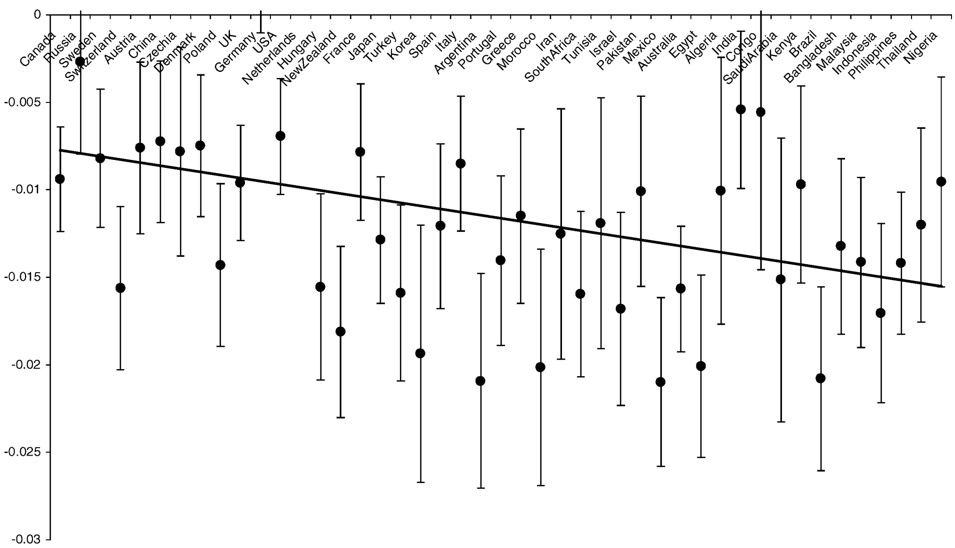


*Figure 2.* The coefficient of temperature squared in Equation (1) for all countries of origin in the sample; the countries of origin are ranked according to their temperature.

per capita income in the home country, with 1.3 (0.5) $10^{-5}$ per additional dollar. This is as expected: people from poor countries are less deterred by poverty, they can less afford holidays in rich countries, and they may not be allowed to travel there.

### 3.3. CONSOLIDATED RESULTS

We separately estimate the relationships that describe the behaviour of tourists from 45 countries. We find that there is a meta-structure in the parameters. That is, there is additional information, not considered in the first regressions. Considering the countries together rather than separately can shed some light on those characteristics of tourist behaviour which are not specific to nationals of any given country but rather common to all consumers of tourist services. By exploiting the information on these common traits, we are able to explain country patterns better. By pooling information, the significance of parameter estimates and the robustness of the results improves. In order to use this information, we run the following procedure: One by one, we omit each country from the analysis above. Based on the original parameter estimates for the remaining 44 countries, we predict the parameter value for the 45th country. We combine this prior information with the likelihood information of the original regression of the 45th country to form the posterior for the 45th country. The equations are

$$\Sigma = (\mathrm{T}^{-1} + \Upsilon^{-1})^{-1} \tag{2}$$

and

$$\beta = \Sigma(\mathrm{T}^{-1}\alpha + \Upsilon^{-1}\gamma) \tag{3}$$

where $\beta$ is the new vector of parameter estimates for Equation (1) and $\Sigma$ is its covariance matrix; $\alpha$ is the original vector of parameter estimates for Equation (1) and T is its covariance matrix; and $\gamma$ is the vector of predicted parameter values and $\Upsilon$ is its covariance matrix. For $\gamma$, we use a zero if no prediction is available; the corresponding diagonal element in $\Upsilon$ is set to infinity. The off-diagonal elements of $\Upsilon$ are all set to zero. The classical equivalent of this Bayesian procedure is mixed estimation by Theil and Goldberger (1961). If we just use the average of the parameter values of the other countries (rather than the average adjusted for temperature or per capita income), this procedure would correspond to a panel data analysis with random effects. With the adjustments for temperature and per capita income, this corresponds to a panel data analysis with cross-terms[11] and random effects.[12]

Table II shows the results for adding information on the optimal holiday temperature, the curvature of the temperature/attractiveness curve (the temperature squared parameter), the distance elasticity, and the poverty aversion. Results are as expected. The estimated optimal holiday temperature per country are shrunk to the global mean optimal holiday temperature, which is 16.2 (0.5)°C. This is no surprise, as the uncertainty about the global mean optimal holiday temperature is much smaller than the typical uncertainty about the country optimal holiday temperature. The standard deviations of the latter vary between 0.8°C and 11.4°C. The consolidated country optimal holiday temperatures do not significantly deviate from the unconsolidated optimal temperature; t-statistics range from −1.31 to 1.34.

TABLE II
Consolidated regression results (standard deviations in brackets)

| | Optimal temperature | Temperature squared | Distance | Per capita income |
|---|---|---|---|---|
| Kenya | 16.2 (0.5) | −0.0141 (0.0014) | −2.3232 (0.2158) | 0.5565 (0.0908) |
| Congo | 16.2 (0.5) | −0.0142 (0.0014) | −2.2678 (0.2361) | 0.5572 (0.0926) |
| Algeria | 16.2 (0.5) | −0.0138 (0.0014) | −2.1888 (0.2350) | 0.5997 (0.0955) |
| Morocco | 16.3 (0.5) | −0.0129 (0.0014) | −2.2289 (0.2372) | 0.5754 (0.0933) |
| Tunisia | 16.2 (0.5) | −0.0130 (0.0014) | −2.1186 (0.2390) | 0.6176 (0.0967) |
| South Africa | 16.2 (0.5) | −0.0130 (0.0013) | −1.8102 (0.2032) | 0.6500 (0.0984) |
| Nigeria | 16.2 (0.5) | −0.0147 (0.0014) | −2.2784 (0.2210) | 0.5400 (0.0914) |
| Canada | 16.4 (0.5) | −0.0074 (0.0013) | −0.9420 (0.2419) | 0.7975 (0.1254) |
| Mexico | 16.2 (0.4) | −0.0141 (0.0013) | −1.7785 (0.2066) | 0.6985 (0.0991) |
| USA | 16.2 (0.5) | −0.0099 (0.0013) | −0.2168 (0.1568) | 1.0695 (0.1520) |
| Argentina | 16.0 (0.5) | −0.0124 (0.0014) | −1.7020 (0.2538) | 0.7279 (0.1094) |
| Brazil | 16.2 (0.5) | −0.0149 (0.0014) | −0.6997 (0.1688) | 0.6797 (0.0959) |
| China | 16.2 (0.5) | −0.0098 (0.0013) | −2.2219 (0.2114) | 0.6063 (0.0920) |
| Japan | 16.3 (0.5) | −0.0113 (0.0013) | −2.0108 (0.2999) | 0.9763 (0.1315) |
| Korea | 16.3 (0.5) | −0.0114 (0.0014) | −1.8209 (0.2795) | 0.7645 (0.1194) |
| Indonesia | 16.2 (0.5) | −0.0149 (0.0014) | −2.3915 (0.2178) | 0.5660 (0.0924) |
| Malaysia | 16.2 (0.5) | −0.0146 (0.0013) | −2.3561 (0.2226) | 0.6675 (0.1027) |
| Philippines | 16.2 (0.5) | −0.0147 (0.0013) | −2.2751 (0.2009) | 0.6051 (0.0919) |
| Thailand | 16.1 (0.5) | −0.0147 (0.0014) | −2.3322 (0.2205) | 0.6345 (0.0969) |
| Australia | 15.8 (0.5) | −0.0139 (0.0013) | −1.8335 (0.3240) | 0.8106 (0.1305) |
| New Zealand | 15.8 (0.5) | −0.0114 (0.0013) | −1.6265 (0.3081) | 0.7441 (0.1205) |
| Czechia | 16.1 (0.5) | −0.0100 (0.0015) | −1.8838 (0.2416) | 0.7009 (0.1088) |
| Hungary | 15.9 (0.5) | −0.0110 (0.0014) | −1.8694 (0.2223) | 0.6770 (0.1041) |
| Poland | 16.0 (0.5) | −0.0106 (0.0013) | −1.9749 (0.2141) | 0.6599 (0.0976) |
| Russia | 16.2 (0.5) | −0.0066 (0.0015) | −2.0755 (0.2337) | 0.6529 (0.0972) |
| Denmark | 16.2 (0.5) | −0.0098 (0.0013) | −1.1639 (0.2800) | 0.8624 (0.1393) |
| Sweden | 16.2 (0.5) | −0.0087 (0.0013) | −1.2839 (0.2708) | 0.8280 (0.1300) |
| UK | 16.3 (0.5) | −0.0102 (0.0013) | −1.0734 (0.2157) | 0.8674 (0.1210) |
| Greece | 16.1 (0.5) | −0.0121 (0.0014) | −1.5406 (0.2477) | 0.7737 (0.1182) |
| Italy | 16.3 (0.5) | −0.0113 (0.0013) | −1.1965 (0.2317) | 0.8901 (0.1235) |
| Portugal | 16.1 (0.5) | −0.0122 (0.0013) | −1.3620 (0.2464) | 0.7877 (0.1153) |
| Spain | 16.2 (0.5) | −0.0116 (0.0013) | −1.0104 (0.1712) | 0.8113 (0.1202) |
| Austria | 16.2 (0.5) | −0.0097 (0.0014) | −1.3686 (0.2641) | 0.8710 (0.1400) |
| France | 16.2 (0.5) | −0.0106 (0.0013) | −1.1833 (0.2460) | 0.8213 (0.1311) |
| Germany | 16.2 (0.5) | −0.0097 (0.0014) | −1.6439 (0.2880) | 0.7688 (0.1387) |

(*Continued on next page*)

TABLE II
(*Continued*)

| | Optimal temperature | Temperature squared | Distance | Per capita income |
|---|---|---|---|---|
| Netherlands | 16.1 (0.5) | −0.0096 (0.0014) | −1.4463 (0.2857) | 0.8296 (0.1443) |
| Switzerland | 16.0 (0.5) | −0.0101 (0.0013) | −0.1217 (0.2189) | 0.9372 (0.1473) |
| Israel | 15.8 (0.5) | −0.0133 (0.0014) | −1.0848 (0.2326) | 0.8203 (0.1256) |
| Turkey | 16.0 (0.5) | −0.0114 (0.0014) | −2.0203 (0.2187) | 0.6057 (0.0959) |
| Saudi Arabia | 16.2 (0.5) | −0.0144 (0.0014) | −1.9063 (0.2590) | 0.6697 (0.1041) |
| Egypt | 16.3 (0.5) | −0.0142 (0.0014) | −2.0963 (0.2130) | 0.5667 (0.0925) |
| Bangladesh | 16.3 (0.5) | −0.0144 (0.0014) | −2.5053 (0.2086) | 0.5722 (0.0915) |
| India | 16.2 (0.5) | −0.0133 (0.0014) | −2.2618 (0.2080) | 0.6032 (0.0903) |
| Iran | 16.2 (0.5) | −0.0126 (0.0014) | −2.1556 (0.2352) | 0.6145 (0.0967) |
| Pakistan | 16.3 (0.5) | −0.0131 (0.0014) | −2.2949 (0.2175) | 0.5810 (0.0919) |

Similar things happen with the other parameters, but in these cases, the estimates are not shrunk to the global mean, but rather to the predicted value, conditional on per capita income or temperature. With regard to the curvature of the temperature/attractiveness relationship, the predictions dominate the initial estimate. As a result, the noise of Figure 2 is considerably reduced, both in terms of country-to-country comparisons, and in terms of uncertainty about the estimated parameters. The consolidated curvature parameters do not significantly deviate from the unconsolidated ones (the t-statistics range from $-1.38$ to 1.67) except for Germany and the Netherlands. Germany and the Netherlands initially had a U-curved relationship between temperature and attractiveness; the consolidated estimates are an inverted U-curve, as expected. For these two countries, the consolidated and unconsolidated parameters do differ significantly at the 5% level.

For the distance elasticity, the predicted parameter values are less dominant, but nonetheless do reduce both types of noise. The consolidated and unconsolidated estimates of distance elasticity are not significantly different at the 5% level, except for Australia, Brazil, Japan and Malaysia. For poverty aversion, the predicted parameter values dominate. The consolidated and unconsolidated estimates of poverty aversion are not significantly different at the 5% level, except for Brazil.

## 4. Discussion and Conclusion

The following results emerge from the above analysis. People from any country prefer the same climate for their holidays. The optimal holiday destination has an average annual temperature of $16.2 \pm 2 \cdot 0.5$°C. Mediterranean countries fall in this range. This conclusion is remarkable. On holiday, people from Canada, Russia and Sweden prefer to be in the same climate as do people from Bangladesh, Brazil and Nigeria. This suggests that basic biological processes drive people's climate preferences, and that acclimatisation to the climates in the places where they do not affect these preferences. This is in line with the physiological evidence presented by Parker (2000).[13] Parker (2000) interprets this in evolutionary terms, and indeed the summer daytime temperatures in Southern France and Northern Italy are similar to the early morning and the late afternoon temperatures that prevail on the savannahs of East Africa.

However, this conclusion does not carry over to the second moment (the temperature squared). People from warmer climates have sharper preferences, are more particular about their choices than are people from colder climates. For example, a Swede would prefer to spend her holiday in the Provence, but would not really object to a holiday in Denmark; an Italian would similarly prefer the Provence, but would feel bad if he ends up in Denmark instead. This result is as remarkable as the first one. As preferences are *assumed* to be symmetrical around the optimum climate, it suggests that people from colder climates have got used to unpleasant weather, and therefore think less of it. The surprising part is not that they do not mind the cold, but they also do not mind the heat. People from hot places avoid cold places for their holidays, as expected, but similarly avoid places that are too hot. Perhaps people from cold climates know they can handle cold but cannot imagine heat, while people from hot places can imagine cold. Another explanation is that the *assumed* symmetry is not real. Introducing asymmetries into the analysis is not trivial, however, and would require a larger number of observations than is currently available. An explanation for this puzzling finding is deferred to future research.

The wider implications for adaptation to climate and climate change readily follow. It has long been argued that people adapt to extreme rather than mean weather (e.g., Katz and Brown, 1992). Here, we find that there is evidence of adaptation in the extremes of behaviour, but not in the mean.

The implications for the impacts of climate change on tourism are also clear. Climate change would drive tourists towards the poles and, for those not interested in sea and sand, up the mountains. Although not analysed here, climate change would also induce people to avoid July and August, and have holidays in June and September instead (in the Northern Hemisphere). A seasonal shift of tourism is limited by holidays, on the demand side (families travelling with school-going children) as well as on the supply side (students form a ready supply of seasonal labour).Tourists from warmer climates would respond more strongly than tourists from colder places. This implies that tourist resorts in places that are likely to become too hot, should strengthen the loyalty of their visitors from cold places but not from hot places. Potential tourist resorts that are likely to become sufficiently warm, should also target tourists from cold countries. Only resorts with a near perfect climate should target tourists from hotter places. Another implication, as the bulk of the future growth of tourism is bound to originate from hotter countries, is that tourism as a whole is likely to become more sensitive to climate change as time passes.

Future research should look into the asymmetries sketched above. It should also study tourist destination choice paying greater attention to spatial and temporal resolution (national and annual is probably not good enough) and to tourist characteristics. A crude study such as this one yields sufficiently interesting results to warrant further research.

## Appendix

TABLE AIa
Regression results per country (standard deviations in brackets)

| | Optimal temperature | Temperature squared | Distance | Income per capita |
|---|---|---|---|---|
| Kenya | 22.2 (5.0) | −0.0097 (0.0056) | −2.45 (0.45) | 0.45 (0.38) |
| Congo | 20.3 (11.4) | −0.0056 (0.0090) | −1.76 (0.87) | 0.52 (0.75) |
| Algeria | 21.1 (6.1) | −0.0101 (0.0076) | −2.89 (0.62) | 0.05 (0.56) |
| Morocco | 17.1 (1.5) | −0.0201 (0.0068) | −2.74 (0.79) | 0.11 (0.54) |
| Tunisia | 20.0 (4.3) | −0.0119 (0.0072) | −2.75 (0.64) | 0.28 (0.53) |
| South Africa | 16.4 (1.1) | −0.0160 (0.0047) | −1.68 (0.31) | 0.57 (0.38) |
| Nigeria | 18.7 (3.5) | −0.0096 (0.0060) | −2.11 (0.51) | 0.17 (0.45) |
| Canada | 18.7 (1.6) | −0.0094 (0.0030) | −0.89 (0.31) | 0.64 (0.22) |
| Mexico | 16.5 (0.8) | −0.0210 (0.0048) | −1.64 (0.32) | 1.13 (0.36) |
| USA | 17.6 (2.2) | −0.0070 (0.0033) | −0.20 (0.16) | 1.14 (0.24) |
| Argentina | 15.5 (1.0) | −0.0209 (0.0061) | −1.81 (0.51) | 1.00 (0.50) |
| Brazil | 16.3 (1.0) | −0.0208 (0.0053) | 0.29 (0.22) | 1.65 (0.43) |
| China | 18.7 (3.2) | −0.0072 (0.0046) | −2.35 (0.40) | 0.85 (0.38) |
| Japan | 17.4 (1.3) | −0.0129 (0.0036) | −3.41 (0.47) | 1.28 (0.26) |
| Korea | 17.8 (1.7) | −0.0194 (0.0073) | −3.03 (0.61) | 1.00 (0.66) |
| Indonesia | 16.1 (1.2) | −0.0171 (0.0051) | −3.01 (0.46) | 0.18 (0.47) |
| Malaysia | 16.6 (1.3) | −0.0141 (0.0049) | −3.38 (0.38) | 0.45 (0.44) |
| Philippines | 16.4 (1.0) | −0.0142 (0.0041) | −2.48 (0.34) | 0.77 (0.36) |
| Thailand | 15.9 (1.8) | −0.0120 (0.0055) | −3.21 (0.42) | 0.70 (0.52) |
| Australia | 14.6 (0.9) | −0.0157 (0.0036) | −3.91 (0.64) | 0.65 (0.29) |
| New Zealand | 14.3 (1.1) | −0.0181 (0.0049) | −3.28 (0.90) | 0.41 (0.39) |
| Czech Rep. | 15.2 (3.2) | −0.0078 (0.0060) | −2.35 (0.43) | 0.49 (0.45) |
| Hungary | 14.2 (1.3) | −0.0155 (0.0053) | −2.05 (0.36) | 0.47 (0.40) |
| Poland | 14.8 (1.5) | −0.0143 (0.0046) | −2.10 (0.36) | 0.71 (0.34) |
| Russia | 15.3 (10.7) | −0.0027 (0.0053) | −2.55 (0.51) | 0.77 (0.39) |
| Denmark | 18.4 (3.3) | −0.0075 (0.0041) | −1.34 (0.39) | 0.78 (0.32) |

(*Continued on next page*)

TABLE AIa
(*Continued*)

| | Optimal temperature | Temperature squared | Distance | Income per capita |
|---|---|---|---|---|
| Sweden | 19.1 (3.1) | −0.0082 (0.0040) | −1.43 (0.40) | 0.78 (0.32) |
| UK | 18.1 (1.8) | −0.0096 (0.0033) | −1.04 (0.26) | 0.92 (0.22) |
| Greece | 15.8 (1.9) | −0.0115 (0.0050) | −1.69 (0.38) | 0.79 (0.37) |
| Italy | 18.4 (2.5) | −0.0085 (0.0039) | −1.22 (0.30) | 1.06 (0.25) |
| Portugal | 15.5 (1.3) | −0.0140 (0.0049) | −1.12 (0.40) | 1.17 (0.40) |
| Spain | 16.7 (1.6) | −0.0121 (0.0047) | −0.87 (0.20) | 1.05 (0.36) |
| Austria | 19.9 (4.5) | −0.0076 (0.0049) | −1.66 (0.36) | 0.85 (0.35) |
| France | 18.7 (2.8) | −0.0078 (0.0039) | −1.28 (0.32) | 0.68 (0.27) |
| Germany[a] | 18.8 (5.6) | 0.0060 (0.0070) | −2.40 (0.44) | 0.04 (0.43) |
| Netherlands[a] | 15.6 (1.8) | 0.0159 (0.0073) | −1.93 (0.42) | 0.39 (0.52) |
| Switzerland | 15.1 (1.2) | −0.0156 (0.0047) | 0.12 (0.25) | 0.99 (0.31) |
| Israel | 14.1 (1.2) | −0.0168 (0.0055) | −0.85 (0.32) | 1.16 (0.47) |
| Turkey | 14.8 (1.3) | −0.0159 (0.0050) | −2.07 (0.41) | 0.16 (0.40) |
| Saudi Arabia | 20.0 (3.6) | −0.0151 (0.0081) | −2.66 (0.73) | 0.35 (0.53) |
| Egypt | 17.0 (1.2) | −0.0201 (0.0052) | −1.89 (0.41) | 0.09 (0.42) |
| Bangladesh | 18.0 (1.8) | −0.0132 (0.0050) | −3.08 (0.39) | 0.75 (0.44) |
| India | 25.9 (9.6) | −0.0054 (0.0045) | −2.29 (0.39) | 1.00 (0.34) |
| Iran | 17.9 (3.1) | −0.0125 (0.0072) | −2.82 (0.58) | 0.18 (0.59) |
| Pakistan | 19.7 (3.2) | −0.0101 (0.0054) | −2.42 (0.46) | 0.87 (0.47) |

[a]This is the least attractive climate.

TABLE AIb
Regression results per country (standard deviations in brackets)

| | Coast | Area | Stability | World heritage | $R^2$ | $N$ |
|---|---|---|---|---|---|---|
| Kenya | 1.1E-05 (1.2E-05) | 5.3E-07 (1.5E-07) | 1.08 (0.54) | 0.00 (0.00) | 0.68 | 32 |
| Congo | 1.9E-06 (1.9E-05) | 5.3E-07 (2.2E-07) | −0.16 (1.11) | −0.64 (0.53) | 0.23 | 26 |
| Algeria | 1.7E-05 (1.6E-05) | 4.7E-07 (2.0E-07) | 0.96 (0.71) | −2.57 (0.02) | 0.57 | 31 |
| Morocco | 3.0E-05 (1.5E-05) | 4.2E-07 (1.9E-07) | 1.05 (0.68) | −1.57 (0.13) | 0.68 | 33 |
| Tunisia | 2.2E-05 (1.5E-05) | 5.1E-07 (1.9E-07) | 0.81 (0.69) | −2.25 (0.04) | 0.62 | 30 |
| South Africa | 2.5E-05 (1.0E-05) | 2.4E-07 (1.0E-07) | 0.99 (0.43) | −1.89 (0.07) | 0.63 | 46 |
| Nigeria | 1.4E-05 (1.2E-05) | 4.5E-07 (1.3E-07) | 0.51 (0.71) | −1.34 (0.19) | 0.47 | 34 |
| Canada | 5.5E-05 (1.8E-05) | 1.6E-07 (7.7E-08) | 0.60 (0.26) | −1.68 (0.10) | 0.68 | 82 |
| Mexico | 2.5E-05 (1.0E-05) | 3.3E-07 (9.8E-08) | 0.90 (0.43) | 0.65 (0.52) | 0.78 | 50 |
| USA | 2.1E-05 (8.4E-06) | 1.8E-07 (9.5E-08) | 0.13 (0.29) | −1.97 (0.05) | 0.64 | 85 |

(*Continued on next page*)

TABLE AIb
(*Continued*)

| | Coast | Area | Stability | World heritage | $R^2$ | $N$ |
|---|---|---|---|---|---|---|
| Argentina | 2.4E-05 (1.4E-05) | 2.2E-07 (1.3E-07) | 0.44 (0.62) | −1.72 (0.09) | 0.58 | 49 |
| Brazil | 2.4E-05 (1.2E-05) | 3.4E-07 (1.5E-07) | −0.24 (0.49) | 0.06 (0.95) | 0.68 | 50 |
| China | 1.1E-05 (1.0E-05) | 2.7E-07 (1.1E-07) | 0.52 (0.43) | −2.06 (0.05) | 0.73 | 52 |
| Japan | 2.4E-05 (8.8E-06) | 2.4E-07 (8.3E-08) | 0.47 (0.33) | −1.71 (0.09) | 0.73 | 76 |
| Korea | 4.1E-05 (1.5E-05) | 2.7E-07 (1.4E-07) | 0.33 (0.73) | 0.60 (0.55) | 0.52 | 48 |
| Indonesia | 2.6E-05 (1.1E-05) | 4.0E-07 (1.1E-07) | 1.57 (0.59) | 2.23 (0.03) | 0.83 | 38 |
| Malaysia | 2.8E-05 (1.0E-05) | 3.3E-07 (1.1E-07) | 1.00 (0.49) | 0.86 (0.40) | 0.80 | 42 |
| Philippines | 2.6E-05 (8.7E-06) | 2.6E-07 (8.7E-08) | 0.15 (0.44) | 0.70 (0.49) | 0.80 | 41 |
| Thailand | 2.2E-05 (1.1E-05) | 2.9E-07 (1.2E-07) | 1.33 (0.60) | 1.57 (0.13) | 0.81 | 37 |
| Australia | 2.8E-05 (8.3E-06) | 1.5E-07 (8.0E-08) | 0.61 (0.34) | −0.38 (0.70) | 0.64 | 56 |
| New Zealand | 2.9E-05 (1.1E-05) | 1.4E-07 (1.1E-07) | 0.85 (0.50) | −0.79 (0.43) | 0.50 | 53 |
| Czech Rep. | 8.2E-06 (1.2E-05) | 2.9E-07 (1.6E-07) | 1.24 (0.56) | −1.50 (0.14) | 0.71 | 41 |
| Hungary | 2.1E-05 (1.1E-05) | 2.0E-07 (1.2E-07) | 1.23 (0.52) | −1.59 (0.12) | 0.77 | 48 |
| Poland | 1.5E-05 (1.0E-05) | 3.3E-07 (1.4E-07) | 0.69 (0.44) | −1.57 (0.12) | 0.80 | 52 |
| Russia | −1.3E-05 (1.2E-05) | 6.1E-07 (1.6E-07) | 0.08 (0.49) | −0.16 (0.88) | 0.62 | 47 |
| Denmark | 1.5E-05 (9.5E-06) | 1.5E-07 (1.0E-07) | 0.57 (0.38) | −1.03 (0.31) | 0.59 | 68 |
| Sweden | 1.8E-05 (9.6E-06) | 9.9E-08 (9.6E-08) | 0.76 (0.39) | 0.00 (0.00) | 0.55 | 69 |
| UK | 2.3E-05 (8.0E-06) | 9.9E-08 (8.0E-08) | 0.42 (0.27) | −0.50 (0.62) | 0.64 | 83 |
| Greece | 1.1E-05 (1.0E-05) | 4.1E-07 (1.2E-07) | 0.61 (0.47) | −1.53 (0.13) | 0.69 | 55 |
| Italy | 1.9E-05 (9.1E-06) | 9.9E-08 (9.2E-08) | 0.25 (0.33) | −1.36 (0.18) | 0.60 | 84 |
| Portugal | 1.5E-05 (1.1E-05) | 3.2E-07 (1.1E-07) | 0.10 (0.47) | −0.78 (0.44) | 0.64 | 60 |
| Spain | 1.4E-05 (1.1E-05) | 1.7E-07 (1.1E-07) | 0.45 (0.43) | −1.78 (0.08) | 0.54 | 71 |
| Austria | 1.7E-05 (1.0E-05) | 2.0E-07 (1.1E-07) | 0.56 (0.42) | −1.29 (0.20) | 0.60 | 66 |
| France | 2.4E-05 (9.6E-06) | 9.9E-08 (9.6E-08) | 0.18 (0.34) | −0.80 (0.43) | 0.51 | 86 |
| Germany | −1.4E-05 (1.7E-05) | −1.5E-07 (1.6E-07) | 0.96 (0.56) | −1.98 (0.05) | 0.51 | 86 |
| Netherlands | −6.4E-05 (2.7E-05) | 1.0E-06 (5.9E-07) | 0.23 (0.59) | 2.30 (0.03) | 0.36 | 66 |
| Switzerland | 2.7E-05 (1.1E-05) | −7.4E-08 (1.1E-07) | 0.58 (0.43) | 0.00 (0.34) | 0.51 | 75 |
| Israel | 1.7E-05 (1.2E-05) | 3.3E-07 (1.3E-07) | 0.14 (0.55) | 0.00 (0.23) | 0.60 | 52 |
| Turkey | 1.4E-05 (1.1E-05) | 3.4E-07 (1.5E-07) | 1.62 (0.54) | 0.00 (0.06) | 0.74 | 51 |
| Saudi Arabia | 3.8E-05 (1.6E-05) | 3.9E-07 (1.8E-07) | 1.29 (0.74) | 0.00 (0.05) | 0.48 | 40 |
| Egypt | 3.4E-05 (1.1E-05) | 4.0E-07 (1.4E-07) | 1.34 (0.54) | 0.00 (0.08) | 0.66 | 42 |
| Bangladesh | 2.4E-05 (1.1E-05) | 4.0E-07 (1.4E-07) | 0.51 (0.48) | −1.52 (0.00) | 0.75 | 35 |
| India | 1.3E-05 (1.1E-05) | 4.1E-07 (1.4E-07) | 0.70 (0.42) | −1.93 (0.00) | 0.74 | 46 |
| Iran | 2.4E-05 (1.5E-05) | 4.3E-07 (1.9E-07) | 0.98 (0.72) | −1.72 (0.00) | 0.50 | 38 |
| Pakistan | 8.0E-06 (1.2E-05) | 4.8E-07 (1.5E-07) | 0.06 (0.52) | −1.10 (0.00) | 0.64 | 40 |

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## Notes

[1]Some add a fourth "s": Safety.

[2]Andorra, Malta, Monaco and San Marino. Data were available for Hong Kong, Macau, Singapore and Liechtenstein.

[3]"Non–negligible" varies between 40 (Malaysia) and 80 kilometres (USA).

[4]We have data for different motives for travel for 13 countries, 7 of which do not generate much tourist activity anyway; none of the 6 remaining is among the 10 most active countries.

[5]Poland, ranking 8th, is particularly active notwithstanding substantially lower per capita income than the rest of the top 10 countries.

[6]A referee pointed out that restrictive visa policies may be another reason why only a few travel abroad.

[7]Climate data for all countries are only available at a monthly resolution.

[8]Travel costs rapidly fall over time, and travel time more slowly, but we study one year only.

[9]We could have used the centroids of the countries instead, but this would have been just a arbitrary and more work.

[10]Figure 2 suggests that the relationship is quadratic, that is, the parameter first falls and then rises. However, temperature squared does not significantly affect the parameter (and its coefficient is in fact of the wrong sign).

[11]Note that the cross-terms are non-linear. We restrict the optimal temperature, which equals $-\alpha_3/2\alpha_4$ at the same, we restrict $\alpha_4$ to be a linear function of per capita income.

[12]We prefer to use our Bayesian method for convenience. Estimating an uneven panel with non-linear cross-terms and random effects is not trivial. Our method has the additional advantage of having separate results for all three steps – national regressions, meta-structure, and consolidated results. A disadvantage of our method is that we cannot test whether the consolidated model is better than the national models.

[13]Note that Mansfeld et al. (2003) find significant differences in weather perception between domestic and foreign tourists on the beach of Eilat, Israel, in March. Notably, foreign tourists, who are mainly from colder and wetter places than Israel, appreciate the weather better than do the Israeli tourists. As Mansfeld et al. (2003) do not study the perceived weather at various destinations, their results neither confirm nor contradict our findings.

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